Process and apparatus for producing thermal and electric energy

The present invention relates to a process according to the preamble of Claim 1 for producing thermal and electric energy in a pulp mill.

According to a method such as this, the spent liquor from chemical pulp digestion is concentrated to form a thick liquor, which is burned in the recovery boiler in the presence of other biogenic fuels. The thermal energy of the flue gases obtained from the combustion is recovered and is, when so desired, converted to electric energy.

The invention also relates to a process according to the preamble of Claim 9 for the production of thermal and electric energy in a sulfate pulp mill and to an apparatus according to the preamble of Claim 19 for the production of a biogenic fuel gas to be fed to the recovery boiler.

It is known that a modern pulp mill is a significant producer of energy. By "pulp mill" is meant in the present invention a mill producing chemical pulp by, for example, the sulfate process. The organic matter arriving at the mill in the raw material and produced in the mill, directed to use as fuel, can be used in all of its three principal states: as a solid, as a liquid and as a gas, and also as a mixture of these. Thus, in its energy production a pulp mill exploits in the chemicals recovery unit the wood material dissolved in the cooking liquor in the pulp digester. In connection with the sulfate process, this recovery unit is also called "soda recovery boiler." The process is called soda recovery boiler process or Tomlinson process. The bark separated from the wood in connection with the debarking of wood is, for its part, burned as a solid material in the bark boiler (hereinafter "bark boiler"). In present-day sulfate pulp mills, there are exploited in energy production also the sludges recovered from the clarification of the debarking plant circulation waters and effluents, the surplus sludge from the biologic treatment process of effluents, as well as strong and dilute odor gases and liquefied methanol, as well as, alongside parallel production, partly pine soap, crude tall oil, birch oil and crude turpentine. There are already being used advanced systems wherein excess sludge, strong and dilute odor gases and methanol are burned in the soda recovery boiler.

The heat generated in the soda recovery boiler, and respectively in the bark boiler, is recovered by generating in the boiler a high-pressure superheated steam, which is directed to a steam turbine for the production of electricity. The steam leaves the turbine in the form of so-called back-pressure steam or bled steam, and its heat content is exploited as process steam in the pulp mill in targets where steam is used or in the production of condensation

electricity. If the pulp mill is integrated into a paper mill, a thermal energy surplus is in general not produced.

A modern sulfate pulp mill produces steam for the turbine plant by the burning of alkali from the soda recovery boiler to such an extent that the share of back-pressure heat and electricity exceeds the heat and electricity consumption of the mill itself, and a portion of the back-pressure heat must be used for producing, in order to reach an equilibrium situation between energy production and consumption, condensation electricity in a condensation section added to the back-pressure turbine. This means that for satisfying its heat and energy needs the pulp mill does not need a bark boiler or heat produced therein by using bark. In this sense, bark is for the pulp mill a surplus fuel, and a bark boiler is an unnecessary investment. The value of bark sold to outside users is significantly reduced by the costs incurred from its transport.

However, in spite of the heat production fuel surplus described above, fossil fuels are used in a pulp mill for the regeneration of lime used in the preparation of digestion liquor; this regeneration is carried out at a temperature above 1000 °C in the lime sludge reburning kiln (drum kiln).

Dried bark and sawdust were gasified to fuel gas (hereinafter generally "fuel gas") as early as the early 1980s for use as fuel gas in the lime sludge reburning kiln, in order to replace the use of fossil fuels. Only a few gasification plants were implemented owing to a strong and long-term drop in the market prices of crude oil.

The targeted increase in the yield of digestion, the recent modifications of digestion, the adoption of oxygen bleaching, and the linking of the bleaching filtrates within the recovery cycle have reduced the caloric value of the fuel, concentrated liquor, of the soda recovery boiler. At the same time the control of the conditions and emissions of the combustion has become increasingly difficult with the increased boiler size. The increasing of the amount of dry matter in the concentrated liquor and of new combustion air distribution systems has only partly solved these problems.

From the patent literature there are known various new options for the exploitation of the intra-process biogenic fuels of pulp digestion. FI Patent Specification No. 102395 discloses a method the principal object of which is to supplement the present-day soda recovery boiler process by exploiting the known separate superheating boiler technology, for which the flue gas is obtained by gasifying a portion of the concentrated liquor. The flue gas is purified before being fed into the superheating boiler, the objective being to lower the alkali level and to hinder soiling of the superheating boiler.

The aim of the method according to FI Published Patent Application No. 82494 is to replace entirely the current combustion processes with a novel refined process wherein the liquor is gasified in a pressurized gasification reactor, and the flue gas formed from the organic material portion and the gas formed from the inorganic material portion are removed from the gasification reactor. The gas is cooled and scrubbed, and the melt is dissolved for being supplied further to the process for the preparation of alkaline cooking liquor. The purified gas is burned to produce steam and electricity in a so-called "gas turbine/steam turbine cycle." What is concerned is thus a process based on pressurized gasification and gas turbine technology.

A similar solution is described in FI Published Patent Application No. 91172, which concerns a process wherein liquor is decomposed thermally in a pressurized reactor at so low a temperature that no melt is formed. The process exploits flue gas, obtained from black liquor, in a gas turbine; the thermal energy present in its exit gases is exploited in a flue gas boiler wherein a portion of the flue gas can also be used for the production of high-pressure steam. The exit gases of the flue gas boiler are directed to a fuel drier, where, for example, bark is dried, which bark is gasified under pressure. The gas can be exploited in superheating the steam (intermediate superheating). The scrubbed gases are combined with gases from the thermal decomposition of black liquor, for being directed to the gas turbine. In this case, also, what is concerned is a process based on pressurized gasification, replacing the current soda recovery boiler process.

A third gas turbine process is disclosed in FI Published Patent Application No. 84516. The object of this known process is to alter the ratio of heat production to electricity production in a sulfate pulp mill so that the sulfate pulp process would be self-sufficient with respect to electricity without, nevertheless, producing steam beyond its own needs. It is proposed that only a steam requirement corresponding to the heat consumption of the plant be run through the steam turbine of the pulp plant and that any excess steam be used, preferably in its entirety, as injection steam in the gas turbine to increase its efficiency.

The gas turbine processes mentioned above are in practice not easy to implement, since replacing the Tomlinson process with the gasification of black liquor is in practice not possible owing to the difficulties involved in pressurized gasification and to the high financial risks associated with the adoption of the new technology, even within a medium range.

It is an object of the present invention to eliminate the drawbacks associated with the state of the art and to provide especially for new, but also for old, pulp mills a suitable option that enables all the bark and other wood-derived fuel produced at the mill and, when necessary, brought from the outside to be exploited effectively in energy production.

The invention is based on the idea that bark and other waste wood is dried to a dry matter content of over 70 %, and the dried bark is gasified to form fuel gas. A substantial proportion of the fuel gas is burned to produce additional heat in the recovery boiler and, when so desired, a portion is burned in some other unit of the mill requiring external fuel, such as the lime sludge reburning kiln of a sulfate mill in order to produce lime sludge reburning regeneration heat. If it is possible to use, for example, tall oil pitch or tall oil in lime reburning, the flue gases are burned in their entirety in the soda recovery boiler.

The fuel gas produced by the process according to the invention can be used for raising the values of the superheated steam produced by the recovery boiler closer to those in present-day power plant boilers in order to improve the yield of electricity. In order to avoid corrosion problems in the recovery boiler, it is preferable to carry out this step in a separate superheating boiler, which may also serve as a so-called pre-chamber for the recovery boiler. In this case the exhaust gases of the superheating boiler are directed to the recovery boiler for the recovery of heat. It is also possible to carry out the superheating of the produced steam in its entirety by using the flue gases produced in the separate burning of fuel gas. The exhaust gases from the separate burning carried out in the superheating boiler or the pre-chamber of the recovery boiler are directed, after the superheaters, to the vaporization part of the recovery boiler.

The invention thus does not aim at replacing the current soda recovery boiler process (Tomlinson process), as is the case in the above-mentioned references, but a biogenic fuel is gasified and burned in direct contact with the burning of concentrated liquor according to the Tomlinson process in a soda recovery boiler. Bark is preferably dried using the flue gases of the soda recovery boiler. In this case there is used for the drying, for example, a drying unit made up of a multi-step dryer cascade. The exit end of this unit is connected to a gasifier producing a fuel gas which can – possibly after purification – be fed into the recovery boiler.

More specifically, the process according to the invention is mainly characterized by what is stated in the characterizing part of Claim 1.

The process according to the invention for using a sulfate mill for the production of thermal and electric energy is for its part characterized by what is stated in the characterizing part of Claim 9.

The apparatus according to the invention is characterized by what is stated in the characterizing part of Claim 19.

Considerable advantages are achieved with the invention. The invention is especially applicable to the sulfate process, but it can also be applied to the soda process, the sulfite process, the polysulfide process, and various organosolv processes. The invention and its advantages are described in greater detail particularly in terms of the sulfate process, but corresponding advantages can also be gained in other commercial processes.

In new pulp mills the process makes the acquisition of a separate bark boiler entirely unnecessary; this considerably lowers the investment costs. The process simplifies the equipment, its operation and maintenance, and improves energy efficiency. In a new sulfate pulp mill, a 10 - 20 % higher thermal energy production capacity is needed in the soda recovery boiler. In old pulp mills the process can be implemented in connection with major basic repairs.

Since the present process is characterized in that fossil fuels are used in a pulp mill only in shutdown, start-up and disturbance situations of the mill, carbon dioxide emissions of fossil origin, which are detrimental to the atmosphere and cause the so-called greenhouse effect, remain very low, although energy efficiency and cost efficiency are improved considerably.

Foreign substances detrimental to the pulp process, such as silicon, aluminum, chlorine and potassium, which may concentrate in the alkali cycle, are carried along with the wood raw material, and thus also with the bark. A gasification technology wherein the ash can be separated and the purification and burning of the fuel gas in the lime sludge reburning kiln and/or soda recovery boiler provide a good opportunity to limit the entry of the above-mentioned detrimental substances into the process.

Dried bark can be used in the energy production of a pulp mill as such or, for example, treated (crushing, grinding, etc.), in which case the targeted final moisture content may remain higher (25 – 35 %). The uses include old bark boilers and the lime sludge reburning kiln, as well as the soda recovery boiler, if the removal of detrimental foreign substances from the alkali cycle can be implemented.

The scope of application of the invention covers, in addition to the waste wood fuels produced at a pulp mill, fuels of wood origin or corresponding fuels acquired from a wood production chain outside the mill or separate fuel production. Peat is also suitable for use as fuel processed in the manner described above.

The acquisition of a bark boiler for a pulp mill costs, depending on the size of the mill, 20 – 30 million euros. It requires operating and maintenance personnel, as well as operating and maintenance materials, in order to function.

The additional investment requirement of a pulp mill according to the process, based on gasification, will be about one-half of the investment in a bark boiler. The operating and maintenance costs of the soda recovery boiler do not increase in consequence to the alteration. The drying of the bark does not require separate operating personnel. The costs of the maintenance of the drying and gasification apparatus remain clearly below the corresponding costs of the bark boiler.

The effect of the process according to the invention on the environmental load depends on the conditions in which the system is applied. The greatest improvement is obtained when the heavy fuel oil of the lime sludge reburning kiln is replaced in accordance with the process with fuel gas (approx. 45 %) and the remainder is burned in the soda recovery boiler (approx. 55 %). In a modern pulp mill this means annually the replacement of approximately 20,000 tons with fuel gas. At the annual level this means approximately 17,500 tons less of detrimental carbon dioxide emissions, and when natural gas is replaced, it means approximately 12,500 tons a year. Also significant is the better than previous control of the combustion in the soda recovery boiler, achieved owing to the increased heat power, which in turn makes it possible to decrease detrimental emissions and, on the other hand, to increase the unit size, which increases economy.

A modern pulp mill (600,000 Adt/d) produces, in an equilibrium state of heat production and operation, 35 – 40 MW of electricity over and above its own need. If approximately 55 % of the above-mentioned gas is directed to the soda recovery boiler for burning, and the increasing steam is directed to the condensation part of the turbine, the excess electricity further increases by approximately 10 MW, and when a separate superheating boiler is used, even more than this. According to the invention it is therefore advantageous to direct at least approximately 40 % of the gas to the recovery boiler.

The above invention will be discussed below with the help of a detailed description, with reference to the accompanying drawings.

Figure 1 shows the general scheme of the first embodiment of the invention, and
Figure 2 shows the detailed process flow scheme of the gasification process of the invention.

As noted above, the soda recovery boiler is, in addition to the steam boiler, an essential chemical reactor in terms of the operation of a pulp mill; this has conventionally limited its use as a site for burning materials other than black liquor. Foreign substances entering the chemicals cycle along with the fuel are detrimental for the regeneration of the cooking

chemicals. The fuel of the lime sludge reburning kiln is required, in addition to being pure, to have a sufficiently hot flame.

According to the present invention there is provided a process wherein the bark and other waste wood produced at the mill can be exploited efficiently in energy production. According to the invention, the bark and other waste wood produced at the mill is dried by means of combustion gases and/or steam to a moisture content below 30 %, is gasified and purified to correspond to the purity requirements of the targeted use. The gas is directed to the recovery unit for the chemicals from pulp cooking, where it is burned together with the concentrated liquor obtained from the waste liquor from digestion.

Preferably the bark or the bark residue is dried to a moisture content of less than 20 % by weight, whereafter it is gasified, and at least 40 % by volume of the gas thus produced is fed into the recovery boiler. Ash is separated from the fuel gas before the gas is fed into the recovery boiler.

The heat produced using fuel gas can be used for example, for the superheating of the soda recovery unit steam in a superheating chamber separate from the flue gases of the soda recovery boiler.

The waste wood to be used in the invention is bark waste, bark-containing sludge, fiber sludge, knot or fiber reject from classification, or surplus sludge from biologic waste water treatment, or logging waste, fuel wood separately harvested from the forest, surplus wood of wood processing, or other wood material suitable for burning.

Bark and other waste wood always requires, in addition to mechanical dewatering, drying with heat before gasification. The required final moisture content is dependent on the combustion temperature obtained with fuel gas and on other properties of the flame. Burning in a lime sludge reburning kiln and a separate superheating boiler requires that the flame should have a high temperature and good radiation properties, in which case a preferred final moisture content after drying is below 20%, typically 10 – 15 %. The moisture content requirement in other use of the fuel gas is not quite as strict. For the drying there is available at a pulp mill waste heat from, for example, the flue gases of the soda recovery boiler. For the drying there is also available surplus heat in the form of bled steam and/or back-pressure steam, if the drying technology would require this, for example, for additional drying.

In the process according to the invention, the water content of the bark is decreased before gasification from 60 % to 30 %, in particular to 20 % or below this (e.g. to approx. 15 %).

By means of the drying of the bark, its significance can be improved significantly in terms of the caloric value of fuel, as is evident from the following calculation:

When the moisture content of bark is 60 %, its effective caloric value is approximately 15.40 MJ/kg, dry matter, 2.50 kg of fuel. When the moisture content of the bark is decreased to 15 %, its effective caloric value increases to a value of 18.86 MJ/kg, dry matter, in this case there is 1.18 kg of fuel.

During drying, the amount of water decreases approximately 1.32 kg/kg dry matter, and the effective caloric value of the bark improves 22.5 %.

Drying thus means an over 20 % increase in the caloric value of moist fuel. The loss of flue gases formed in connection with burning decreases and the efficiency of the burning improves. The boiler structures also decrease as compared with those of a bark boiler. The improving of the caloric value and the efficiency in combustion increase energy production with bio-fuels and reduce the amount of greenhouse gases.

According to a preferred embodiment, steam is used as energy for the drying of solid fuel at a pressure level of 0.01...100 bar (a) or, however, preferably at a pressure level that is in the distribution pressure of the bled steam or back-pressure steam network at a level of 0.4...20 bar, preferably 2...14 bar. It is also possible to use as energy for the drying of solid fuel the excess heat in, for example, various warm waters and expansion steams at the pulp mill.

According to the invention, the entire bark amount of a pulp mill is dried to a low moisture content, typically to a moisture content below 20 %, in particular below 15 %. The thermal power obtained from the bark is in this case in the form of gas approximately 80MWh/h in a modern pulp mill.

The gas obtained from dried bark is suitable for being burned as such as hot gas combustion in the lime sludge reburning kiln or the soda recovery boiler.

According to a preferred embodiment, the drying is carried out by using gases having a temperature of 200 °C, preferably 180 °C or lower than this, in order to prevent the emission of volatile organic compounds. The drying can be carried out in two or several steps, in which case it is preferable to carry out in particular the first step by using flue gases or steam that has a temperature below 200 °C. In this case the exit gases from the drying can be combined with the exit gases from the recovery boiler. The final temperature of the flue gases of the soda recovery boiler is at present at a level of 160 °C, and the flue gas amount is so large that it suffices well to dry the amount of bark produced in the mill. For the dry-

ing of the solid fuel there is generally used the heat remaining after the actual heat recovery in the flue gas formed in the combustion chamber, by bringing the flue gas into direct contact with the solid fuel to be dried.

In the first drying step, the aim is to remove at least 50 % of the moisture content of the material being treated. Preferably the moisture content of the material is at maximum 40 % by weight, most suitably 30 % by weight, after the first step. The second step (other steps) can be carried out in conditions similar to those in the first step or at a higher temperature, since the amount of exit gas from the second drying step, possibly containing VOC, is advantageous for possible purification.

The material obtained from the drying may, before gasification, be brought to a suitable granule/particle size, which varies according to the apparatus option used in the gasification. The material size is also affected by the drying technique applied in the process, since it is essential that the bark or corresponding waste wood be so finely divided that the above-mentioned dry matter contents are achieved through drying. Preferably the wood material is brought to a size of 0.1 – 100 mm.

In the gasification, the dried wood material (bark/waste wood) is heated to form combustible gases. The gasification is carried out in a manner known *per se*, typically in under-stoichiometric conditions as regards oxygen, for example in the presence of a solid heat transfer material in a fluidized bed. Apparatus options suitable for the gasification are discussed in greater detail in connection with the description of the figures.

On the basis of what is stated above, the apparatus used in the invention for producing, from tree bark, a biogenic fuel to be fed into the recovery boiler of a pulp mill, the apparatus being connected to the feed unit of the recovery boiler, comprises as a combination a bark drying unit having feed means for the bark to be dried and outlet means for the dried bark, and a dried bark gasification apparatus for producing fuel gas from bark, the apparatus having feed means for bark and outlet means for fuel gas. The feed means of the gasifier are connected to the outlet means of the drying unit, and the gas outlet means are connected to the feed unit of the recovery boiler in order to feed into the boiler the fuel gas produced by gasification. In this context the word “connected” means that the apparatus is in direct or indirect contact with the subsequent or preceding apparatus. There may be separate treatment units between the apparatuses, as is evident from the following. The “feed means” and respectively “outlet means” are usually pipes or units or similar means through which the materials and products which are to be treated/have been treated can be transferred to the apparatus and respectively removed therefrom. In the drying unit or in its

individual dryers there are used for the drying, for example, flue gases and/or steam, as stated above.

Multi-step drying and its advantages were discussed above. Preferably the drying unit indeed comprises at least two separate dryers arranged as a dryer cascade, in which case the outlet means of the dryer subsequent in the series are connected to the feed means of the gasifier. In an apparatus installation such as this it is possible to arrange a pretreatment unit for the treatment of the bark obtained from the first drier before it is fed into the second drier. The pretreatment unit in this case has a feed unit or feed pipe, which is connected to the outlet means of the first drier, and an outlet unit, which is connected to the feed means of the second dryer. Such a pretreatment unit preferably comprises a grinder.

The first and the second drier may be various bed driers, including fluid-bed driers. The gasifier is most preferably a fluid-bed boiler having an ebullating or rotary bed. The outlet means of the gasifier is most preferably connected to a gas scrubbing unit to separate impurities from the fuel gas before it is fed into the recovery boiler.

A significant proportion, preferably most, of the formed fuel gases are burned in the recovery boiler (soda recovery boiler) in order to produce superheated steam. A portion of the formed gas, having a sufficient fuel value, can be directed to the lime sludge reburning kiln as fuel to replace oil and natural gas. The fuel gas can additionally be used even elsewhere in the integrated mill as a fuel replacing fossil fuel.

By means of the invention, the energy efficiency of the current soda recovery boiler process is developed by exploiting the bark obtained from the debarking of wood and by using already known drying and gasification technologies, as well as gas treatment technology. The concept of one boiler (no bark boiler) is also a key objective, especially when a new pulp mill is concerned. This presupposes the drying and gasification of the entire bark amount; this is possible especially when direct flue gas drying by means of the flue gases from the soda recovery boiler is exploited.

Heat produced with fuel gas produced by gasification is also suitable for the superheating of the soda recovery boiler steam in a superheating chamber separate from the flue gases of the soda recovery boiler. In this case the values (pressure and temperature) of the superheated steam of the soda recovery boiler can be raised and the efficiency of electricity production can be improved from the present values to values closer to those of superheated steam of actual power plant boilers without being limited by the superheating unit corrosion conditions which are now critical. A pulp mill will not need for the exploitation of bark and other organic material separated from the wood at the mill a separate bark boiler

based on the use of solid fuel. The mill concept will be simplified and it will be more economical both to acquire and to operate. Furthermore, the use of fossil fuels at the mill can be reduced decisively. A part of the superheating can be carried out, for example by a technique known *per se*, in a separate superheating boiler by exploiting product gas obtained from bark by gasification. This enables the rate of production of countercurrent electricity be raised by means of bark.

Figure 1 depicts the principle of the process flow of a preferred embodiment of the process according to the invention.

Reference numeral 2 in this case indicates the mechanical treatment of the wood raw material 1 arriving at the mill, the treatment including the debarking and chipping of logs. The chips 3 and the bark and other raw material parts 4 (waste wood such as branches) not suitable for digestion are treated separately, the chips being fed in the conventional manner further to the fiber line 5 of the mill. The bark 4 is fed to gasification 6. At least a portion of the gas, preferably at least 10 % (of the gas volume), most suitably at least 40 %, especially preferably at least 50 %, is fed into the soda recovery boiler 7, into which the biosludge 8 obtained from the treatment of waste waters is also fed. The gases are burned in the soda recovery boiler together with concentrated waste liquor to produce superheated steam 9. A portion of the gas formed, having a sufficient fuel value, may be directed to the lime sludge reburning kiln 10 as fuel to replace oil and natural gas. The fuel gas can additionally be used even elsewhere in the integrated mill (for example, in an auxiliary boiler) as a fuel replacing fossil fuel.

The heat produced with fuel gas prepared by gasification is also suitable for the superheating of the soda recovery boiler steam in a superheating chamber separate from the flue gases of the soda recovery boiler.

According to a preferred embodiment of the invention (see Figure 2), there are constructed at the pulp mill a bark dryer 11, 13 and a gasifier 14, which are dimensioned for the entire bark amount, in which case the bark is dried by using the hot gases of the pulp mill, such as flue gases, especially flue gases of the soda recovery boiler, having a temperature below 200 °C, or steam. Flue gas drying based on direct contact can be used for the drying.

The bark can be dried in one or more steps, for example two as shown in Figure 2, in which case in the first step 11, where the bark is still wet, flue gases and bed drying are used. The second drying step can be carried out at a higher temperature. The bark is dried to a dry matter content of approximately 60 – 80 % by weight. Thereafter the bark can be subjected to a pre-treatment 12, such as grinding. In the second drying step 13, steam and,

for example, fluid bed drying are used. In both steps it is preferable to maintain a low drying temperature in order to achieve a low emission level. In general, approximately 150 – 170 °C is a sufficient temperature. After the second drying step the dry matter content is over 80 %, preferably approximately 82 – 90 %.

The second drying step may also be carried out at a higher temperature of, for example, 250 – 400 °C.

After the drying, the bark and corresponding solid waste are gasified 14. Typically the gasification temperature is approximately 700 – 1000 °C, preferably approximately 750 – 900 °C. For the gasification it is possible to use fluid-bed boilers having, for example, an ebullating bed or rotary bed. The product gas obtained from the gasification, which mainly contains carbon monoxide, is directed to gas purification 15. The bark ash contains foreign substances such as aluminum and silicon, the concentration of which in the lime and alkali cycle can be prevented by the gasification of the bark and the separation of the ash from the gas.

The need for gas purification varies according to its targeted use. From the gas to be used in the soda recovery boiler 16, tars and ammonia have to be removed in addition to the fly ash. A portion (in practice approximately 40 % by volume) is directed to the lime sludge reburning kiln 17, in which case the purification of the gas need not be as efficient in order to maintain the flame properties. The purification need is mainly targeted at ammonia when NO_x emissions are to be limited.

A substantial proportion of the fuel gases, most suitably at least 55 % by volume, are directed to the soda recovery boiler. Preferably the combustion chamber of the soda recovery boiler is in this case divided in the flow direction of the flue gases into two parts, in the first one of which there is burned the fuel brought into a gaseous state, the heat produced therefrom being used to a significant degree for the superheating of steam, and in the second one there is burned the concentrated liquor, the heat produced therefrom being primarily used for the vaporization of the boiler water.

The gas obtained from the gasification 14 can be used not only as a fuel gas for the soda recovery boiler and the lime sludge reburning kiln but also elsewhere, for example in the oil vessel 18, for the drying 19 of pulp, and in some other context, for example, for heating needs. It may also be sold to outside the mill, generally for purposes where its use replaces the use of fossil fuels (district heating, use in a paper mill). In Figure 2, reference numerals 21 and 22 indicate the initial material containers (bark piles) and reference numerals 23 and 24 indicate silos for the dried material. Reference numeral 21 indicates the storage for

purchased fuel, and numeral 22 a container for material coming from the debarking plant. When so desired, the initial material may be pre-treated 25. This concerns material 25 coming from the outside or the debarking plant, which material is subjected to a suitable mechanical treatment, for example, by means of the apparatus of the debarking plant, to render the material suitable for drying and gasification.

The material obtained after the first drying step can be collected in a silo 23, from which it is sold to outside the mill.

By "treatment of the gases" is meant, for example, the purification of the gas (VOC) obtained from the second gasification step 13.

In the foregoing, the production of fuel gas particularly from gas has been described. The invention can also be applied to solid waste wood of other kinds, such as bark-containing sludge, fiber sludge, branch or fiber rejects from classification, or surplus sludge from biologic wastewater treatment. The biogenic fuel to be gasified may also consist of logging waste collected from the forest and/or fuel wood separately harvested from the forest and/or surplus wood from wood processing and/or other wood material suitable for burning.